"COMPARISON OF THREE DIFFERENT PHYSIOTHERAPEUTIC INTERVENTIONS IN IMPROVING HAMSTRING FLEXIBILITY IN INDIVIDUALS WITH HAMSTRING TIGHTNESS"

A DISSERTATION SUBMITTED TO THE TAMILNADU

Dr. M.G.R MEDICALUNIVERSITY, CHENNAI,

AS PARTIAL FULFILLMENT OF THE

MASTER OF PHYSIOTHERAPY DEGREE

APRIL 2012

CERTIFICATE

Certified that this is the bonafide work of **Mr.M.Ramesh** of K.G. College of Physiotherapy, Coimbatore submitted in partial fulfillment of the requirements for the Master of Physiotherapy Degree course from the Tamil Nadu Dr.M.G.R. Medical University under the **Registration No: 27102204** for the April 2012 Examinations.

Date: **Principal**

A Dissertation on

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has been submitted in partial fulfillment for the requirement of the Master of Physiotherapy degree,

April 2012

Internal Examiner **External Examiner**

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Under the guidance of,

Principal: ……...

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I. INTRODUCTION

Hamstring is the common muscle which undergoes for adaptive shortening comparing with other major muscle groups.

Hamstring refers to the three posterior thigh muscles or to the tendons that make up the borders of the space behind the knee. They usually refer to the posterior thigh muscle or the tendons of the semitendinosus, semimembranosus and biceps femoris. The three muscles of the posterior thigh will flex the knee while all but the short head of biceps femoris extend the hip.

Tight hamstring affect posture, gait, and the way that the body moves during exercise. Hamstring tightness occurs due to immobilization of a tissue in a shortened position which results in decreased elasticity of normal tissue, a change in the length tension relationship of the muscle and loss of flexibility.

Flexibility, weakness and neuro muscular control are the primary contributing factors that lead to the hamstring tightness. Frequency and duration of muscle stretching may interfere with improvement of flexibility. The reduced flexibility involve biomechanical, neurological and molecular changes.

A lack of flexibility in the hamstring muscles will contribute to any hamstring problem or can be the cause of problem. When the hamstring muscles are tight they cause the hip to tilt backwards as the leg is extended.

Tight hamstrings pull the pelvis and hips out of their natural alignment, compromising posture as result, the back flattens and losing some of its natural curve.

The loss of flexibility can also cause pain arising from muscle, connective tissue or periosteum. (Hardy 1989, Tillman and Cummings 1992)

Lack of motion also results in increased cross bonding or adherence between collagen fibres (Cummings and Tillman, 1992)

If hamstring become evenly tight, they become much more prone to injury and also because of the length tension relationship with the quadriceps, the knee joint can become unbalanced and more likely to develop osteoarthritis. Loss of flexibility of hamstrings may lead to decrease in lumbar lordosis, reduction of muscle strength, and quadriceps dysfunction during gait.

Physiotherapy management for improving flexibility of hamstrings includes static stretching, ballistic stretching, mulligans traction straight leg raise, muscle energy technique, ultrasound therapy and short wave diathermy along with stretching exercises. These techniques were significant in improving the hamstrings flexibility.

Stretching techniques such as cyclic stretching and static stretching have been used to enhance muscular flexibility (Worrell et al 1994).

Gains in flexibility are dependent as the duration of stretching position and researcher show the best “stretch – hold position” is 30 seconds (Bandy 1994)

(Feland et al 2001) reported that longer hold times during stretching of the hamstring muscles resulted in a greater rate of gains in range of motion.

With regard, to important role of hamstring flexibility, restoration of its normal length is necessary. In this reason, different methods such as ultrasound therapy and stretching were studied (Guffy and Kuaust 1997)

Researchers were emphasised on the thermal effects of continuous ultrasound compared to other heating modalities in increasing flexibility (Lehmann et al 1968; Sonnen1997)

(Falconer et al 1992) showed that ultrasound increases soft tissue extensibility and may be an effective adjunct in the treatment of knee contractures secondary to connective tissue shortening.

The muscle energy technique is claimed to be effective for a variety of purposes including lengthening a shortened muscles, as a lymphatic or venous pump to and drainage of fluid or blood and increases range of motion.

(Bourdillonj 1998) suggested that muscle energy technique may be useful, where muscle shortening is the primary factor. The restrictions which taken place as a result of tight, shortened muscles is usually accompanied by some degree of lengthening and weakening of the antagonists.

1.1 NEED FOR STUDY

According to the previous literature, muscle energy technique, ultrasound therapy with active static stretching, passive static stretching were significant in improving the hamstring flexibilty in individuals with hamstring tightness. But there was no study which compares the effect of muscle energy technique and ultrasound therapy with active static stretching, passive static stretching in improving the hamstring flexibility in individuals with hamstring tightness.

1.2 STATEMENT OF THE PROBLEM

Effect of muscle energy technique and ultrasound therapy with active static stretching, passive static stretching in improving the hamstring flexibility in individuals with hamstring tightness.

1.3 AIM

To compare the effect of muscle energy technique and ultrasound therapy with active static stretching, passive static stretching in improving the hamstring flexibility in individuals with hamstring tightness.

1.4 OBJECTIVE OF THE STUDY

- To study the effect of muscle energy technique in improving the hamstring flexibility in individuals with hamstring tightness.
- To study the effect of ultrasound therapy with active static stretching in improving the hamstring flexibility in individuals with hamstring tightness.
- To study the effect of passive static stretching in improving the hamstring flexibility in individuals with hamstring tightness.
- To compare the effect of muscle energy technique and ultrasound therapy with active static stretching, passive static stretching in improving the hamstring flexibility in individuals with hamstring tightness.

1.5 KEY WORDS

Hamstring tightness

Muscle energy technique

Ultrasound therapy

Stretching

Hamstring flexibility

Active knee extension test

1.6 HYPOTHESIS

1.6.1 NULL HYPOTHESIS

There is no significant difference between the three different physiotherapeutic interventions in improving hamstring flexibility in individuals with hamstring tightness.

1.6.2 ALTERNATE HYPOTHESIS

There is significant difference between the three different physiotherapeutic interventions in improving hamstring flexibility in individuals with hamstring tightness.

II.REVIEW OF LITERATURE

HAMSTRING TIGHTNESS

- **Kishner and Colby et al., (2002)**

  Stated that adequate mobility of soft tissues and joints is thought to be an important factor in prevention of injury (or) reinjury to soft tissues.

- **Andrew Kusiak., (2001)**

  Stated that flexibility is a key component for prevention of injury and rehabilitation, stretching decreases injury and improves performance in sports for overall fitness. Hamstring as one of the commonest muscles often gets tight as the biomechanics of hamstrings are complex because they pull over two joints - hip and knee. Therefore, their efficacy in producing force at knee is dictated by the angle of hip joint. Greater hamstring force is produced with hip in flexion when hamstring is lengthened over joint, regardless of knee position **(Andrew Kusiak 2001).** Tight hamstrings can have profound effect on seated postural alignment. Posterior pelvic tilt is a primary effect, with resultant kyphotic thoracic spine and stress on cervical spine either hyper extended or flexed. If hamstrings are unequally tight, the pelvis will rotate away from

tighter hamstrings. For example; if right hamstrings are tighter, the pelvis will rotate towards left **(Jiawei Han, Micheline Kamber 2001)**.

Reduced hamstring muscle flexibility has been implicated in lumbar spine dysfunction, with number of studies showing positive correlation between decreased hamstrings, flexibility and low back pain **(Abraham Silberschatz, Henry Korth, Sudarshan S 2001)**.

- **Pawlak Z., (1998)**

  Stated that muscle tightness is a limiting factor for optimal physical performance and an important intrinsic factor for sports injury.

- **Sarhmann.S et al., (1997)**

  Stated that muscle tightness and hypertonicity has a significant impact on the neuromuscular control. Muscle tightness affects the normal length tension relationship.

- **Zachazewski et al.,(1989)**

  Stated that loss of flexibility of hamstring may lead to decrease in lumbar lordosis, reduction of muscle strength and quadriceps dysfunction during gait.

- **Cummings, GS, Crutchfeld, CA, Barnes et al., (1983)**

  Stated that tightness is referred to mild shortening of a healthy musculotendinous unit otherwise referred to as a mild transient contracture. A muscle that is "tight" can be lengthened to all but the outer limits of its range. Normal individual who do not regularly participate in a flexibility program can develop mild myostatic contractures or tightness, particularly in two joint muscles such as hamstrings, rectus femoris or gastronemius.

MUSCLE ENERGY TECHNIQUE

- **Ahmad Faheem, Ahmad Shamin,et al., (2010)**

  Conducted a study to compare the impact of muscle energy technique and eccentric training on popliteal angle/hamstring flexibility in Indian collegiate males. Twenty Indian collegiate males with age between 18-25 years, having tightness in hamstring muscles were included in the study. Hamstring tightness was measured by popliteal angle/active knee extension test. One group was treated with muscle energy technique and the other with eccentric training. They concluded that muscle energy technique using post isometric relaxation resulted in maximum improvement as compared to eccentric training on hamstring flexibility.

- **Wassim M et al., (2009)**

  Studied the efficacy of muscle energy technique on hamstring muscles flexibility in normal Indian collegiate males. Hamstring muscle flexibility was measured active knee extension test. They concluded that muscle energy technique is significantly improving the hamstring flexibility in collegiate males.

- **Azadeh Shadmehr, Mohmmed Reza Hadian, Sedigheh Sadet Naiemi, Shohreh Jalaie et al.,(2009)**

  Concluded that the hamstring stretches in normal young women using either static stretch or muscle energy technique had similar effects on restoring flexibility to hamstrings.

- **JishaThampi et al., (2007)**

  Stated that post isometric relaxation and static stretching are effective in reducing the hamstring tightness. When both groups are compared post isometric relaxation was found to be more effective than static stretching.

- **Ching shan anita et al, (2003)**

  Stated that muscle energy technique appeared to be more effective than passive stretching for increasing hamstring extensibility immediately post treatment and still at 1 hour later.

- **Ballantyne F, Fryer G, MC.Laughlin P et al., (2003)**

  Conducted a study to find the effectiveness of muscle energy technique in increasing passive knee extension and to explore the mechanism behind any observed change. Forty asymptomatic subjects between the age of 18 to 45 years were randomly allocated to experimental and control group. Experimental group was given with muscle energy technique and Control group was given with no treatment. They concluded that muscle energy technique produced an immediate increase in passive knee extension. This observed change is due to an increased tolerance to stretch.

- **Feland J et al (2001), Mehta M et al (2002)**

  Stated that muscle energy technique has been shown to improve muscle extensibility than passive static stretching both in the short and long term.

- **Chaitow, L, Clark, MA, Ellerin, BE, Heflet, D et al,(1999),(2001)**

  Stated that muscle energy techniques are manipulative procedures that have evolved out of osteopathic medicine and are designed to lengthen muscle and fascia and mobilise joints. The procedures employ voluntary muscle contraction by the patient in a precisely controlled direction and intensity against a counterforce applied by the practitioner, Because principle of neuromuscular inhibition are incorporated into this approach, another term used to describe these techniques is post isometric relaxation.

- **Lewit, Libenson, Murphy et al., (1999)**

  Stated that post isometric relaxation is an excellent technique for treating neuromuscular component muscle of a stiff, shortened or tight muscle.

- **Chaitow L, Liebenson CL et al., (1997)**

  Stated that muscle energy technique have the ability to relax over active muscles or stretch tight muscles and their associated fascial components when connective tissue or visco elastic changes have occurred.

- **Chaitow L et al., (1997)**

  Stated that the isometric contraction should be held for 10 seconds. This is the time required to stimulate the excitatory threshold of the golgi

tendon organ, which has a neurophysiologic inhibitory effect on the muscle spindle, this provides the opportunity to take the muscle into a new range of motion. Following the isometric contraction, there is a latency period of approximately 25 to 30 seconds, during which the muscle can be stretched.

- **Bandy et al., (1997)**

  Identified that 30 seconds as the optimal duration for an effective stretch Muscle energy technique which can maintain muscle elongation for this duration may produce increased muscle length by a combination of creep and plastic change in the connective tissues. **(Fryer G 2000, Ross A Clark 2008)** An increase in flexibility after muscle energy technique (MET) occurred due to biomechanical or neuro-physiological changes or due to an increase in tolerance to stretching **(Freyer G. et al 2000, Richard L, et al 1993)**

- **Lederman E., (1997)**

  Stated that passive stretching a muscle principally stretches the connective tissue elements arranged parallel with the muscle fibres. It has been proposed that when the stretched muscle isometrically contracts, the contracting filaments place tension and stretch on the

tougher “in series” connective tissue elements, which are not normally tensioned by passive stretch. Thus post isometric relaxation may principally be a biomechanical event: a combination of viscoelastic creep and plastic change in parallel and series connective tissue elements of the muscle, above and beyond that obtained by passive stretch.

- **Kuchera & Kuchera (1992), Denslow et al., (1993)**

  Stated that effect of muscle energy technique may result from the inhibitory golgi tendon reflex, activated during the isometric contractions that leads to reflex relaxation of the muscle, as a result of post isometric relaxation (PIR).

- **Lewit et al (1999), Greenman et al.,(1989)**

  Suggested that in muscle energy technique, the holding time of 7-10 seconds is more effective than 3-5 seconds.

- **Chaitow L,(19970, Evjenth O (1984), Holt LE et al., (1976)**

  Stated that muscle energy techniques are manually applied stretching technique that use principles of neurophysiology of relax over active muscles and / or stretch chronically shortened muscles. In autogenic inhibition after a muscle contracts it is automatically in a relaxed state for

a brief latent period. Measurements of the Hoffman reflex (representative of the excitability of the alpha motor neuron pool) show that activity is decreased for 25 to 30 seconds following muscle energy technique, whereas inhibition from static stretching lasts only 3 to 5 seconds. These effects are neurophysiologically mediated **(Michael A Clark,2007)**

ULTRASOUND THERAPY WITH ACTIVE STATIC STRETCHING

- **Meroni R, Cerri CG, Lanzarini C, Barindelli G, Morte GD, Gessaga V, Cesana GC, De Vito G et al., (2010)**

  compared the effect of passive and active stretching technique on hamstring flexibility of healthy subjects. Hamstring flexibility was assessed by active knee extension test. They concluded that active stretching showed greater gain in hamstring flexibility than passive static stretching group.

- **Shadmehr a, Astaneh H N** et al., (**2009)**

  Studied the effect of continous versus pulsed mode of ultrasound therapy on flexibility of short hamstrings in young healthy male population. They concluded that the heating effect of continous ultrasound was more

effective than non thermal properties of pulsed ultrasound for increasing flexibility of shortened hamstring.

- **Nichole Lee Lounsberry et al.,(2008)**

  Stated that the ultrasound treatment produced greater immediate gains in hamstring extensibility than moist heat packs treatment.

- **Buker N., Aslan E., Kitis A., Carluk U et al.,(2008)**

  Stated that the superficial (or) deep heat applications before static stretching exercises showed positive effects to increasing flexibility of hamstring muscles.

- **A.Akbari, H.Moodi, A.A.Moein and R.Nazok et al., (2006)**

  Stated that the gains in range of passive knee extension obtained in continuous therapeutic ultrasound and 30 seconds stretch group were significantly greater than continous therapeutic ultrasound and 15 seconds stretch group in subjects with tight hamstrings.

- **Winstein, C, Iyer MB, Mitz AR et al, (2004)**

  Stated that when tension develops in a muscle the golgi tendon organ fires and inhibits alpha motor neuron activity thereby decreases tension in the muscle tendon unit being stretched. If a low intensity, slow stretch force is applied to muscle, the stretch reflex is less likely to be activated as the golgi tendon organ fires and inhibits tension in muscle, allowing the parallel elastic component (the sarcomeres) of the muscle to remain relaxed and lengthen

- **Odunaiya N.A, Hamzat T.K, Ajayi O et al., (2004)**

  Stated that statically stretching tight hamstrings for any duration between 15 and 120 seconds on alternate days for six weeks would significantly increase its flexibility. The effect was also sustained for upto 7 days post intervention.

- **Draper, DO, Castro, JL, Feland B, Richard, MD et al, (2004)**

  Stated that, superficial heat such as hot packs, paraffin or deep heating modalities such as ultrasound, short wave diathermy provide different mechanism to heat tissues. These thermal agents are used primarily to heat small areas such as individual joints, muscle group, or tendon and may be applied prior to or during the stretching procedure.

- **TraeSakiyoTashiro et al., (2003)**

  Stated that the clinically practical parameters of thermal ultrasound in conjunction with active static stretching is an effective way of increasing hamstring extensibility but ultrasound application location didn't showed difference in increasing knee extension range of motion in a healthy population.

- **Mitchell FL., (1993)**

  Stated that warming up soft tissue prior to stretching is a common practice in rehabilitation and fitness programs. It is well documented in human and animal studies that as increase in intramuscular temperature increases the extensibility of contractile and noncontractile soft tissues **(Knight KL 1989, Wessling KC et al 1987).** Warming up prior to exercise reduces postexercise muscle soreness and the risk of injury to soft tissues **(Zachazewski JE 1990)**.

- **Folconer et al., (1992)**

  Stated that ultrasound increases soft tissue extensibility and may be an effective adjunct in the treatment of knee contractures secondary to connective tissue shortening.

- **Gordon and Ghez et al.,(1991)**

  Stated that active static stretching may be effective in increasing the length of muscle due to the prolonged stretching which allows the muscle spindle to adapt over time and cease firing.

- **Low and Reed et al.,(1990) , Dyson et al.,(1987)**

  Stated that low absorption of ultrasound waves is seen in tissues that are in water content (eg.,fat), whereas absorption is higher in tissues rich in protein (e.g., skeletal muscle).

- **Ziskin et al., (1986)**

  Stated that an increasing in tendon length following continuous ultrasound therapy is due to change of their viscosity and plasticity.

- **Coakley et al.,(1978)**

  Stated that ultrasound at a frequency of 1MHZ is absorbed primarily by tissues at a depth of 3 to 5cms and is therefore recommended for deeper injuries and in patients with more subcutaneous fat.

  Elevation of collagen tissue temperature affects on the mechanical and physical characteristics of tissues and facilitates deformation of the

collagen. Thus, pain and discomfort was reduced during stretching and collagen fiber ability to tolerate greater forces was increased.

- **Lehman et al., (1968)**

  Emphasized on the thermal effects of continuous ultrasound compared to other heating modalities in increasing hamstring flexibility.

PASSIVE STATIC STRETCHING

- **Carolyn Kisner and Lynn Allen Colby., (2007)**

  Stated that, if a slow stretch force applied to muscle, the golgi tendon organ fire and inhibits the tension in the muscle, allowing the parallel elastic component (the sarcomere) of the muscle to lengthen.

- **Odunaiyan.A., Hamzatt.k., et al.,(2005)**

  The study shows that statically stretching tight hamstrings for any duration between 15 and 120 seconds on alternate days for 6 weeks would significantly increase its flexibility.

- **A.P. Marques, A.A.P. Vasconcelos, et al., (2001)**

  Stated that stretching exercises performed three times a week were sufficient to improve flexibility and range of motion compared to subjects exercising once a week, with results similar to those of subjects who exercised five times a week**.**

- **WD Bandy.,(1994)**

  Suggested that duration of 30 seconds is an effective time of stretching for enhancing the flexibility of the hamstring muscles.

- **Bandy,WB, Irion,JM et al (1994)**

  Carried out daily stretching of the hamstring muscle for 15, 30, or 60 seconds they determined that 30 and 60 second stretches increased range of motion more than a 15 second stretch but there was no significant difference in the effectiveness of 30 and 60 second stretches.

- **Gaidosik et al .,(1991)**

  Stated that static stretching increased straight leg raise with concomitant increases in the maximal hamstring length and the maximal resistance to passive stretching.

ACTIVE KNEE EXTENSION TEST

- **C.M. Norris et al.,(2005)**

  Stated that active knee extension test along with goniometry, accurate surface making and manual monitoring of the test leg is a reliable measure of hamstring muscle length.

- **M.Mathews et al.,(2005)**

  Stated that active knee extension test represents maximum length of the hamstring muscles.

- **Denise M. Cameron, Richard W. Bohannon et al.,(1985)**

  Stated that active knee extension test is said to be a useful alternative test to the straight leg raise test for providing an indication of hamstring muscle length.

- **Gajdosik R.L et al.,(1983)**

  Stated that active knee extension test produces high reliability co-efficient which is a more objective measure of hamstring tightness.

III. METHODOLOGY

3.1 STUDY DESIGN:

Pre test and post test experimental group study design.

3.2 STUDY SETTING:

Study will be conducted at Physiotherapy Out Patient Department, KG College of Physiotherapy, Coimbatore.

3.3 STUDY DURATION:

Total duration was one year. Each individual received the treatment for the duration of two weeks.

3.4 POPULATION STUDIED

45 individuals with hamstring tightness who fulfilled the predetermined inclusive and exclusive criteria were selected and divided into 3 experimental group by simple random sampling method. Each group consists of 15 patients. Groups are named as group A, B, and C.

3.5 CRITERIA FOR SELECTION

3.5.1 INCLUSIVE CRITERIA:

- Age between 18 to 25 years
- Both males and females
- Normal individuals with tight hamstrings (inability to achieve greater than 160° knee extension with hip at 90° flexion)

3.5.2 EXCLUSIVE CRITERIA:

- Acute or chronic low back pain.
- Acute or chronic hamstring injury.
- Soft tissue injuries around knee.
- Pregnancy.
- Metal implants in lower extremity.
- Recent fracture and stiffness in lower extremity.

3.6 VARIABLES:

3.6.1 INDEPENDENT VARIABLES:

- Muscle energy technique.
- Ultrasound therapy with Active Static stretching.
- Passive Static Stretching.

3.6.2 DEPENDENT VARIABLES:

- Hamstring flexibility.

3.7 PARAMETERS:

- Hamstring flexibility

3.8 MEASUREMENT TOOLS:

- Active knee extension test

3.9 PROCEDURE

GROUP A

MUSCLE ENERGY TECHNIQUE

Technique used: Post isometric relaxation

Individual's position: Supine lying

Ask the individual to assume supine position. Therapist flexes the affected hip fully and then extends the flexed knee with the back of lower leg resting on the shoulder of the therapist who stands facing the head of the table. Individual is asked to flex ie.causing downward pressure against the therapists shoulder with back of lower leg at the same time therapist resist the individual voluntary effort so that, slight isometric contraction of hamstrings develops and individuals hold this for 10 seconds, after this effort, the individual is asked to exhale and relax the muscle completely. Then the therapist takes the muscle to its new restriction barrier without stretch. Starting from its new barrier, the same procedure is repeated two or three more times.

Frequency of Treatment: Once in a day

Treatment Duration: Two weeks

GROUP B

ULTRASOUND THERAPY WITH ACTIVE STATIC STRETCHING

ULTRASOUND THERAPY

Individual's position: Prone lying

Parameters

Frequency: 1MHZ

Mode: Continuous

Intensity: 2 W/cm²

Area of application: Hamstring area

Duration: 5 minutes daily

Frequency of treatment: Once in a day

Treatment duration: Two weeks

ACTIVE STATIC STRETCHING

TECHNIQUE USED

Active static stretching

INDIVIDUALS POSITION

Standing position

PROCEDURE

Individual was asked to perform the hamstring stretch by standing erect with foot planted on the floor and toes pointing forward. The heel of the foot to be stretched is placed on a plinth with toes directed towards ceiling. Individual then flexed forward at the hip, maintaining the spine in neutral position while reaching the arms forward.

The subjects is continued to flex the hip until a gentle stretch is felt in the posterior thigh. Then hold this position for 30 seconds and then relax for 10 seconds and repeat the same procedure for three more times a day.

Frequency of treatment: Once in a day

Treatment duration: Two weeks.

GROUP C

PASSIVE STATIC STRETCHING

Individual was asked to relax, and therapist flexed the individual's hip and extended their knee until the point of maximum stretch tolerance of their hamstring muscle. This was held for 30 seconds and then placed back into a neutral position.

Frequency of treatment: Once in a day

Treatment duration: Two weeks.

3.10 STATISTICAL TOOLS

Analysis of variance (ANOVA):

Analysis of variance is a statistical technique specially designed to test whether the means of more than two quantitative populations are equal.

The basic principle of ANOVA is to test for differences among the means of the populations by examining the amount of variations within each of these samples, relative to the amount of variation between the samples.

Formula:

$$F = \frac{S_1^2}{S_2^2}$$

Where, S_1^2 is $S_1^2 = \frac{\Sigma(X_1 - \bar{X}_1)^2}{n_1 - 1}$

S_2^2 is $S_2^2 = \frac{\Sigma(X_2 - \bar{X}_2)^2}{n_2 - 1}$

IV.DATA ANALYSIS AND INTERPRETATION

TABLE-I

ANOVA

One way ANOVA for pre test values of hamstring flexibility between and within all groups

Source of variation	Sum of squares	Degrees of freedom	F ratio
Between groups	4.044	2	0.1465
Errors	579.7	42	
Total	583.8	44	

TABLE-II

ANOVA

One way ANOVA for post test values of hamstring flexibility between and within all groups

Source of variation	Sum of squares	Degrees of freedom	F ratio
Between groups	354.2	2	11.98
Errors	620.8	42	
Total	975.0	44	

TABLE-III

PAIRED‘t’ TEST

PRE TEST AND POST TEST VALUES OF GROUP A

GROUP A - MUSCLE ENERGY TECHNIQUE

HAMSTRING FLEXIBILITY – ACTIVE KNEE EXTENSION

S.NO	GROUP A	MEAN	STANDARD DEVIATION	‘t’ VALUE
1.	Pre test	134	3.67	21 .0
2.	Post test	150	2.71	

GRAPH I

GRAPHICAL REPRESENTATION OF PRE AND POST TEST VALUES OF GROUP A (MUSCLE ENERGY TECHNIQUE)

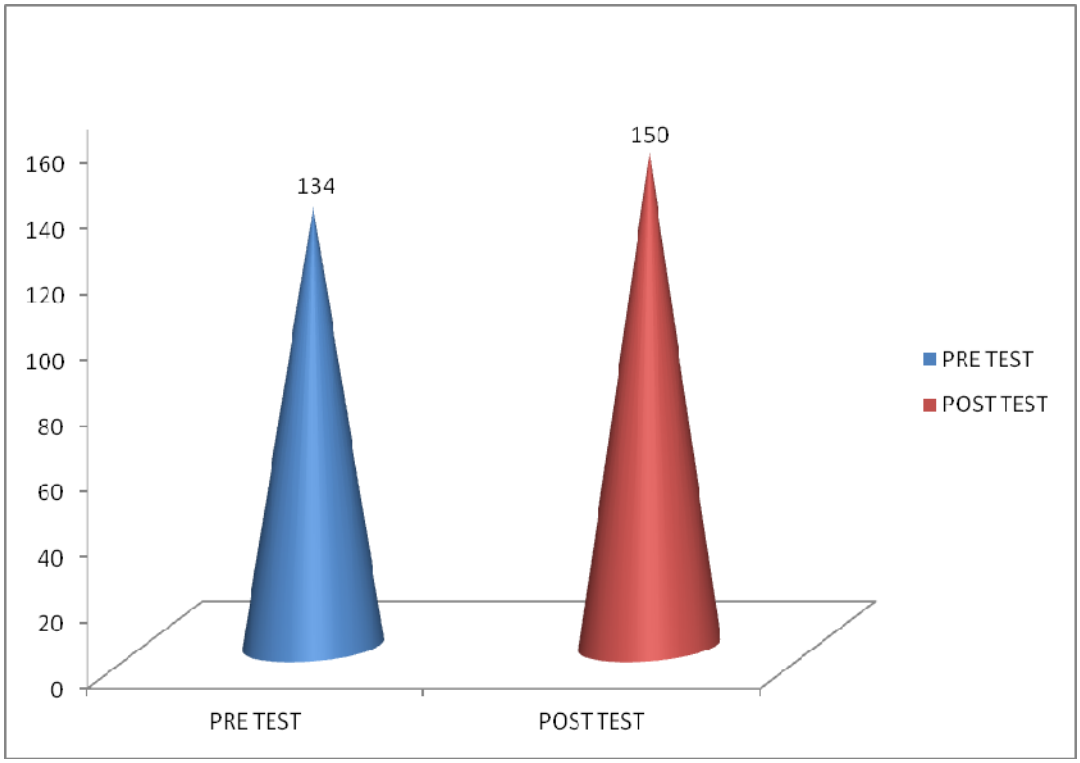


TABLE-IV

PAIRED‘t’ TEST

PRE TEST AND POST TEST VALUES OF GROUP B

GROUP B - ULTRASOUND THERAPY WITH ACTIVE STATIC STRETCHING

HAMSTRING FLEXIBILITY – ACTIVE KNEE EXTENSION

.

S.NO	GROUP B	MEAN	STANDARD DEVIATION	‘t’ VALUE
1.	Pre test	133	4.03	15.6
2.	Post test	146	3.75	

GRAPH II

GRAPHICAL REPRESENTATION OF PRE AND POST TEST VALUES OF GROUP B (ULTRASOUND THERAPY WITH STATIC STRETCHING)

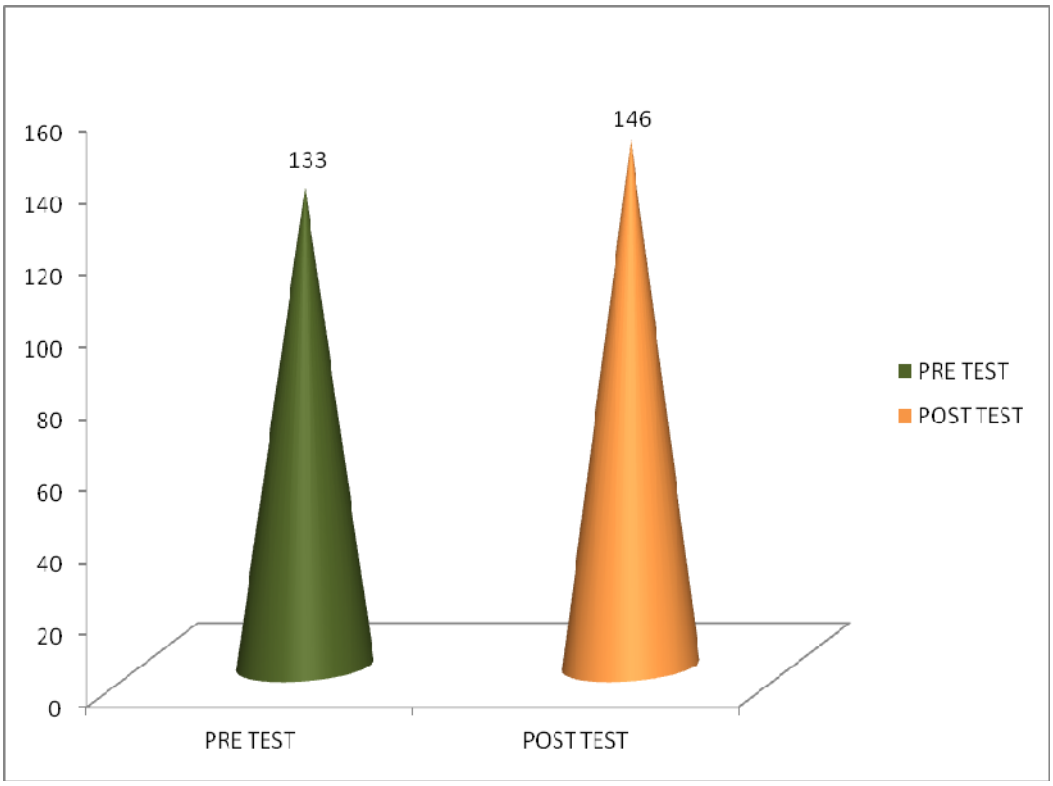


TABLE-V

PAIRED‘t’ TEST

PRE TEST AND POST TEST VALUES OF GROUP C

GROUP C- PASSIVE STATIC STRETCHING

HAMSTRING FLEXIBILITY – ACTIVE KNEE EXTENSION

S.NO	GROUP C	MEAN	STANDARD DEVIATION	‘t’ VALUE
1.	Pre test	134	3.42	11.8
2.	Post test	143	4.79	

GRAPH- III

GRAPHICAL REPRESENTATION OF PRE AND POST TEST VALUES OF GROUP C (PASSIVE STATIC STRETCHING)

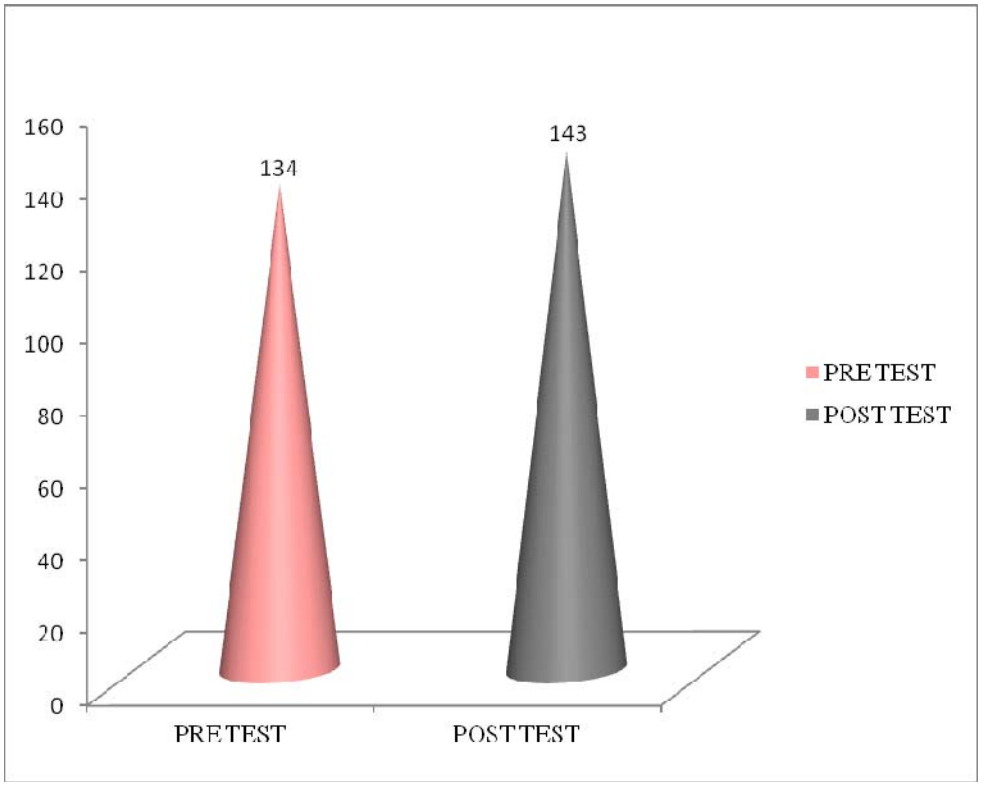


TABLE-VI

UNPAIRED‘t’ TEST

POST TEST VALUES OF GROUP A AND B

HAMSTRING FLEXIBILITY – ACTIVE KNEE EXTENSION

S.NO	GROUPS	MEAN	STANDARD DEVIATION	‘t’ VALUE
1.	Group A	146	3.75	3.07
2.	Group B	150	2.71	

GRAPH-IV

GRAPHICAL REPRESENTATION OF POST TEST VALUES FOR GROUP A AND GROUP B:

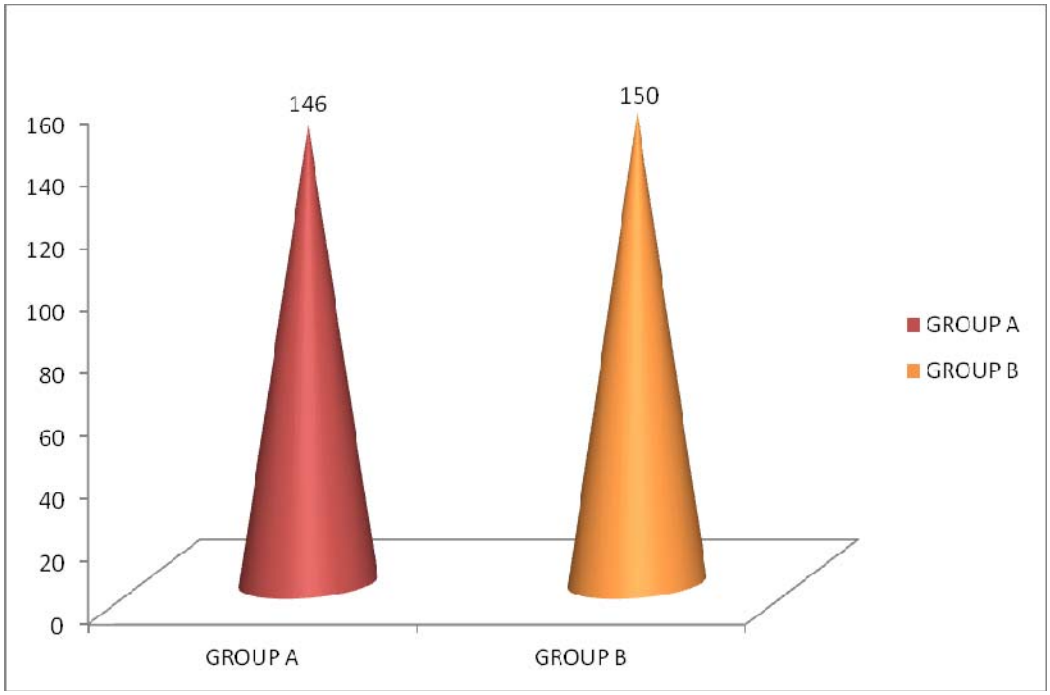


TABLE-VII

UNPAIRED‘t’ TEST

COMPARISON BETWEEN THE POST TEST VALUES OF GROUP B AND C

HAMSTRING FLEXIBILITY – ACTIVE KNEE EXTENSION

S.NO	GROUPS	MEAN	STANDARD DEVIATION	‘t’ VALUE
1.	Group B	143	4.79	2.04
2.	Group C	146	3.75	

GRAPH- V

GRAPHICAL REPRESENTATION OF POST TEST VALUES FOR GROUP B AND GROUP C:

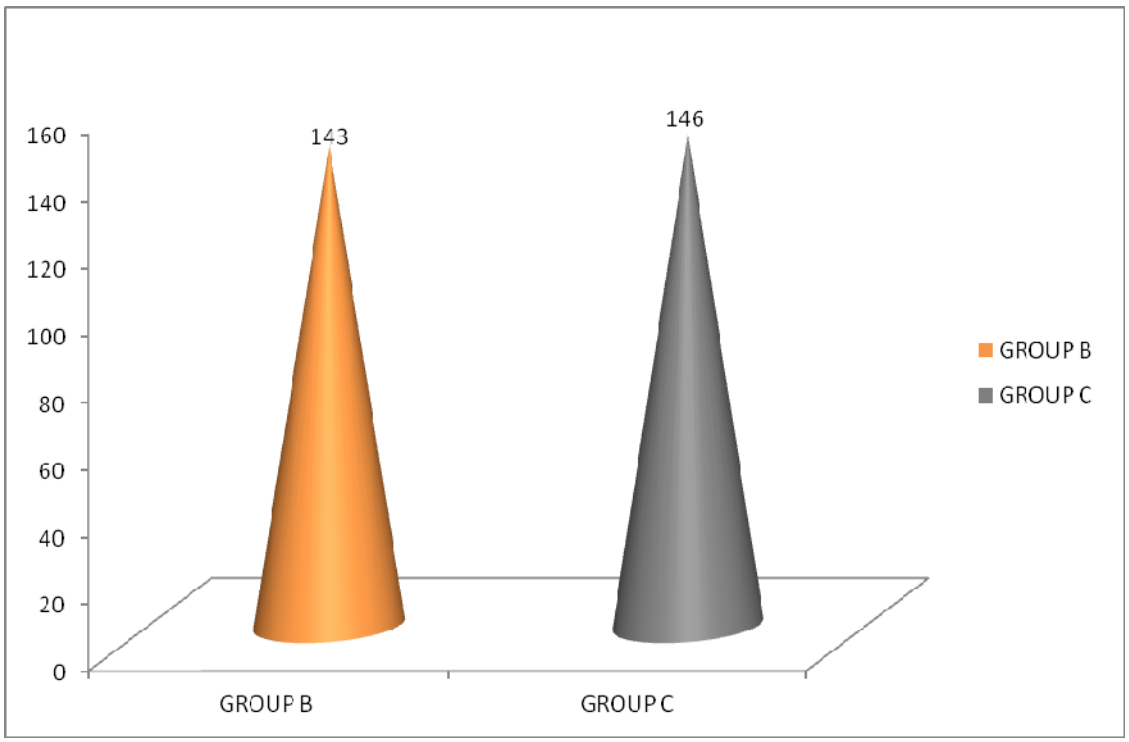


TABLE-VIII

UNPAIRED‘t’ TEST

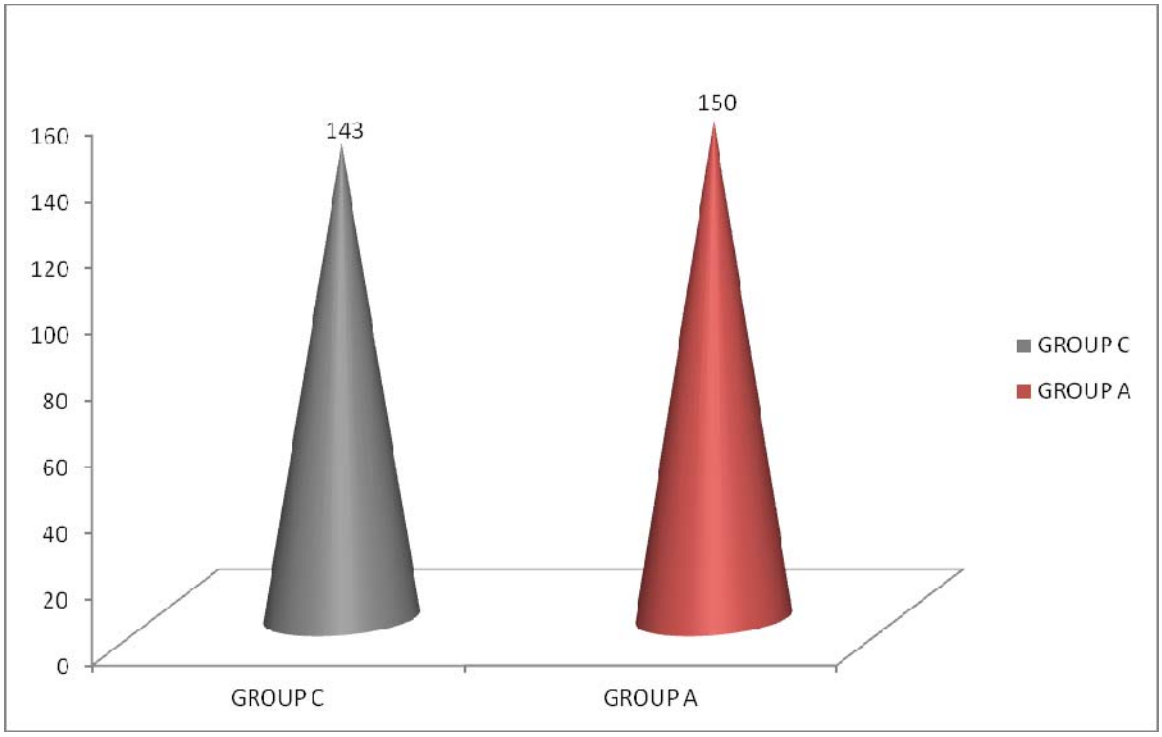
COMPARISON BETWEEN THE POST TEST VALUES OF GROUP C AND A

HAMSTRING FLEXIBILITY – ACTIVE KNEE EXTENSION

S.NO	GROUPS	MEAN	STANDARD DEVIATION	‘t’ VALUE
1.	Group C	143	4.79	4.83
2.	Group A	150	2.71	

GRAPH-VI

GRAPHICAL REPRESENTATION OF POST TEST VALUES FOR GROUP C AND GROUP A:



V.ANALYSIS OF RESULTS:

45 individuals with hamstring tightness were divided into three groups. Group A were treated with muscle energy technique. Group B were treated with ultrasound with active static stretching and group C with passive static stretching. Hamstring flexibility was measured by active knee extension test.

Statistical analysis was done by using one way analysis of variance (ANOVA) and Student‘t’ test. One way analysis of variance (ANOVA) was done to find out any variance between the groups and within all samples in all three groups. Paired ‘t’ test was used to find out the improvement within the group. Unpaired ‘t’ test was used to find out the difference between the groups.

One way analysis of variance (anova)

Pre test values of hamstring flexibility between and within all groups

The observed F ratio for analyzing the variance between the groups in the critical region (critical value) is 3.22. This is lesser than calculated value of 0.1465. So there is no significant difference in hamstring flexibility between the groups before the application of treatment intervention.

Post Test Values Of Hamstring Flexibility Between And Within All Groups

The observed F ratio for analyzing the variance between the groups in the critical region (critical value) is 3.22. This is greater than calculated value of 11.98. So there is a significant difference in improving hamstring flexibility between the groups after the application of treatment intervention.

Paired‘t’ test:

Group A – Muscle Energy Technique

Using Paired‘t’ test with 14 degrees of freedom and 5% at level of significance, the calculated ‘t’ value is 21.0 which is greater than table ‘t’ value 1.761.This test showed that there is a significant effect of muscle energy technique in improving the hamstring flexibility in individuals with hamstring tightness.

GROUP B – Ultrasound Therapy With Active Static Stretching

Using Paired‘t’ test with 14 degrees of freedom and 5% at level of significance, the calculated ‘t’ value is 15.6 which is greater than table ‘t’ value 1.761.This test showed that there is a significant effect of ultrasound therapy

with active static stretching in improving the hamstring flexibility in individuals with hamstring tightness.

GROUP C – Passive Static Stretching

Using Paired‘t’ test with 14 degrees of freedom and 5% at level of significance, the calculated ‘t’ value is 11.8 which is greater than table ‘t’ value 1.761. This test showed that there is a significant effect of passive static stretching in improving the hamstring flexibility in individuals with hamstring tightness.

Unpaired‘t’ test:

(a) Comparing post test values of active knee extension test between Group A and Group B:

Post test values of Group A and Group B is analysed by Unpaired‘t’ test. The calculated‘t’ value is 3.07 which is lesser than table‘t’ value 1.701 at 5% level of significance. This test showed that there is no significant difference between the effect of muscle energy technique and ultrasound therapy with active static stretching in improving hamstring flexibility in individuals with hamstring tightness.

(b) Comparing post test values of active knee extension test between Group B and Group C:

Post test values of Group B and Group C is analysed by Unpaired‘t’ test. The calculated‘t’ value is 2.04 which is greater than table‘t’ value 1.701 at 5% level of significance. This test showed that there is a significant difference between the effect of ultrasound therapy with active static stretching and passive stretching in improving hamstring flexibility in individuals with hamstring tightness.

(c) Comparing post test values of active knee extension test between Group C and Group A:

Post test values of Group C and Group A is analysed by unpaired‘t’ test. The calculated‘t’ value is 4.83 which is greater than table‘t’ value 1.701 at 5% level of significance. This test showed that there is a significant difference between the effect of passive static stretching and muscle energy technique in improving hamstring flexibility in individuals with hamstring tightness.

VI. DISCUSSION

This study was done to find out the effect of three different physiotherapeutic interventions in improving hamstring flexibility in individuals with hamstrings tightness.

45 subjects who fulfilled inclusive and exclusive criteria were selected and divided into 3 groups as 15 in each group. Group A underwent muscle energy technique, Group B underwent ultrasound therapy with active static stretching, and Group C underwent passive static stretching. Hamstring flexibility was measured by using active knee extension test.

Statistical analysis was done by using one way analysis of variance (ANOVA), unpaired ‘t’ test and paired ‘t’ test.

One way analysis of variance (ANOVA) was done to find out any variance between the groups and within all the samples in all the three groups. One way ANOVA for pretest values of hamstrings flexibility showed that there was no significant difference between and within the three groups in improving hamstrings flexibility. One way analysis of variance (ANOVA) for post test values of hamstrings flexibility showed that there was significant difference

between and within the three groups in improving hamstring flexibility in individuals with hamstrings tightness.

Further in this study, Paired‘t’ test was used to find out improvement within the group and Unpaired ‘t’ test was used to compare the effect between the two groups.

In group A, Paired‘t’ test showed that there was significant effect of muscle energy technique in improving hamstring flexibility in individuals with hamstrings tightness. This result was consistent by previous studies as follows

Postisometric relaxation may principally be a biomechanical event: a combination of viscoelastic creep and plastic change in parallel and series connective tissue elements of the muscle, above and beyond that obtained by passive stretch. Lederman E 1997.

Effect of muscle energy technique may result from the inhibitory golgi tendon reflex, activated during the isometric contractions that leads to reflex relaxation of the muscle, as a result of post isometric relaxation (PIR). Kuchera & Kuchera 1992, Denslow 1993 et al**.**

Muscle energy technique using post isometric relaxation resulted in maximum improvement as compared to eccentric training on hamstring flexibility**.** Ahmad Faheem, Ahmad Shamin,et al 2010

Muscle energy technique is significantly improving the hamstring flexibility in normal Indian collegiate males. Wassim M et al 2009.

In group B, Paired‘t’ test showed that there was significant effect of ultrasound therapy with static stretching in improving hamstring flexibility in individuals with hamstrings tightness. This result was consistent by previous studies as follows

Increasing in tendon length following continuous ultrasound therapy is due to change of their viscosity and plasticity (Ziskin et al 1986). Active static stretching may be effective in increasing the length of muscle due to the prolonged stretching which allows the muscle spindle to adapt over time and cease firing. Gordon and Ghez et al 1991.

The gains in range of passive knee extension obtained in continuous therapeutic ultrasound and 30 seconds stretch group were significantly greater than continuous therapeutic ultrasound and 15 seconds stretch group in subjects with tight hamstrings. A.Akbari, H.Moodi, A.A.Moein and R.Nazok et al 2006.

In group C, Paired‘t’ test showed that there was significant effect of passive static stretching in improving hamstring flexibility in individuals with hamstrings tightness. This result was consistent by previous studies as follows

- If a slow stretch force applied to muscle, the golgi tendon organ fire and inhibits the tension in the muscle, allowing the parallel elastic component (the sarcomere) of the muscle to lengthen. Carolyn Kisner and Lynn Allen Colby., 2007

Daily stretching of the hamstring muscle was carried out for 15,30, or 60 seconds, it was determined that 30 and 60 second stretches increased range of motion more than a 15 second stretch but there was no significant difference in the effectiveness of 30 and 60 second stretches. Bandy, WB, Irion, JM et al1994.

When comparing the posttest values of group A and B by using Unpaired‘t’ test. The results showed that there was significant difference between the effect of group A and B in improving hamstring flexibility. So muscle energy technique is better than ultrasound therapy with active static stretching in improving hamstring flexibility in individuals with hamstrings tightness. This may be due to Muscle energy techniques are manually applied stretching technique that use principles of neuro physiology to relax over active muscles and / or stretch chronically shortened muscles. In autogenic inhibition after a muscle contracts it is automatically in a relaxed state for a brief latent period. Measurements of the Hoffman reflex (representative of the excitability of the alpha motor neuron pool) show that activity is decreased for 25 to 30 seconds following muscle

energy technique, whereas inhibition from static stretching lasts only 3 to 5 seconds. These effects are neurophysiologically mediated**.**Chaitow L,1997 Evjenth O Holt LE, et al 1984. An increase in flexibility after muscle energy technique (MET) occurred due to biomechanical or neuro-physiological changes or due to an increase in tolerance to stretching. Freyer G. et al 2000, Richard L, et al 1993.

When comparing the posttest values of group B and C by using unpaired‘t’ test. The results showed that there was significant difference between the effect of group B and C in improving hamstring flexibility. So ultrasound therapy with active static stretching is better than passive static stretching in improving hamstring flexibility in individuals with hamstrings tightness.

Elevation of collagen tissue temperature affects on the mechanical and physical characteristics of tissues and facilitates deformation of the collagen. Thus, pain and discomfort was reduced during stretching and collagen fiber ability to tolerate greater forces was increased.Coakley 1978.Emphasized on the thermal effects of continuous ultrasound compared to other heating modalities in increasing hamstring flexibility Lehman et al 1968.Active static stretching showed greater gain in hamstring flexibility than passive static stretching group. Meroni R, Cerri CG, Lanzarini C, et al 2010.

When comparing the posttest values of group A and C by using unpaired‘t’ test. The results showed that there was significant difference between the effect of

group A and C in improving hamstring flexibility. So muscle energy technique is better than passive static stretching in improving hamstring flexibility in individuals with hamstrings tightness. Muscle energy technique has been shown to improve muscle extensibility than passive static stretching both in the short and long term. Feland J et al 2001, Ferber R et al 2002, Mehta M et al 2002.

Passive static stretching fire the golgi tendon organ and inhibits the tension in the muscle, allowing the parallel elastic component (the sarcomere) of the muscle to lengthen. Where the ultrasound therapy with active static stretching elevates the collagen tissue temperature and increases the extensibility of the soft tissues.

In case of muscle energy technique, effects are neurophysically mediated. Following muscle energy technique, alpha motor neuron pool excitability was decreased for 25 to 30 seconds during which the muscle can be stretched or taken to new restriction barrier whereas inhibition from static stretching lasts only 3 to 5 seconds. Therefore an increase in muscle length may be due to biomechanical event: a combination of viscoelastic creep and plastic change in parallel and series connective tissue elements of the muscle, neurophysiological changes, increase in tolerance to stretching.

This study concluded that muscle energy technique is better than ultrasound therapy with active static stretching and passive static stretching improving hamstring flexibility in individuals with hamstring tightness.

VII. SUMMARY AND CONCLUSION

The aim of this study was to compare the effect of three different physiotherapeutic interventions in improving hamstring flexibility in individuals with hamstring tightness.

45 subjects were selected in the age group between 18 to 25 years after due consideration of inclusion and exclusion criteria. The subjects were allotted into three groups.

Group A received muscle energy technique group B received ultrasound therapy with active static stretching and group C received passive static stretching. Hamstring flexibility was measured by active knee extension test. The values of outcome measures were recorded before the beginning of treatment regime and at the end of treatment regime.

Statistical analysis was done by using student‘t’ test and one way analysis of variance, Paired‘t’ test was used to find out the improvement within the group. Unpaired‘t’ test was used to find out the difference between the groups

and one way analysis of variance was used to find out any variance between the groups and within all samples in all three groups.

The results showed that there was a significant difference between muscle energy technique, ultrasound therapy with active static stretching and passive static stretching in improving hamstring flexibility in individuals with hamstring tightness.

This study concluded that muscle energy technique is more effective than ultrasound therapy with active static stretching and passive static stretching in improving the hamstring flexibility in individuals with hamstring tightness.

VIII. LIMITATIONS AND RECOMMENDATIONS

- Sample studied was small and the study reduces the generalising ability therefore study with a much larger population is recommended.
- This is a short term study, a long term study is necessary to make the results valid
- Hamstring flexibility can also recorded by passive knee extension test.
- Study can be aimed to find out the effect of muscle energy technique with the other modalities such as hot pack, short wave diathermy and other interventions such as proprioceptive neuromuscular facilitation techniques, eccentric training, for further research.
- Follow up study can be conducted in order to find out lasting effect of the physiotherapeutic interventions on hamstring flexibility.

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X.APPENDIX

APPENDIX I

SUBJECTS' PROFILE:

Name: Age: Sex:

Occupation:

Date of admission:

Chief complaints:

History:

Past medical history:

Present medical history:

Drug history:

Associated problems:

Pain history:

Site:

Side:

Onset:

Duration:

Type:

Nature:

Intensity:

Frequency:

Aggravated factors:

Reliving factors:

Vital signs:

Temp:

Pulse:

Resp. Rate:

B.P:

ON OBSERVATION

Built:

Posture:

External Appliances:

Deformities:

Swelling:

Bony contour:

Gait:

Skin changes:

Patient’s expression:

Patient’s attitude:

ON PALPATION:

Tenderness:

Warmth:

Oedema:

Pulse:

Trigger point:

Taut band:

ON EXAMINATION

Range of motion:

Region	Active ROM		Passive ROM	
	Right	Left	Right	Left
Knee				

End feel:

Muscle power:

Muscle tightness:

Muscle girth:

Accessory movements:

Deep tendon reflex:

Sensation:

Limb length discrepancy:

Gait:

Deformity:

Functional assessment:

Special test:

Investigations:

Diagnosis:

Problem list:

Aims:

Means:

Home program:

APPENDIX II

ACTIVE KNEE EXTENSION TEST

The subject was in supine position with hip flexed 90 degrees and knee flexed. Pelvis was strapped down to the table for stabilization and controls the accessory movements. The fulcrum of the goniometer was centered over the lateral condyle of the femur with the proximal arm secured along the femur using greater trochanter as a reference. The distal arm was aligned with the lower leg using the lateral malleolus as a reference.

APPENDIX III

CONSENT FORM

This is to certify that I _____ freely and voluntarily agree to participate in the study " **Comparison Of Three Different Physiotherapeutic Interventions In Improving Hamstring Flexibility In Individuals With Hamstring Tightness".**

I have been explained about the procedures and the risks that would occur during the study.

Participant:

Witness:

Date:

I have explained and defined the procedure to which the subject has consented to participate.

Researcher:

Date: